DERWENT-ACC-NO: 2002-134983

DERWENT-WEEK: 200218

TITLE: Mixed-loading electrical wiring optical distribution line multilayer sheet manufacture involves patterning conductor sheet bonded on one surface of optical waveguide sheet surface, to form electrical wiring pattern

INVENTOR: FUJIMAKI S; KAMIKAWA S ; MAENO K ; MITA M ; MIYAMOTO H ; SHISHIDO K ; SUZUKI M

PATENT-ASSIGNEE: NIIGATA OKI DENKI KK[NIIGN] , OKI ELECTRIC IND CO LTD[OKID]

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INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	G02B6/13	20060101

ABSTRACTED-PUB-NO: JP 2001311846 A

BASIC-ABSTRACT:

NOVELTY - A conductor sheet is bonded to the flexible optical waveguide sheet surface provided with the optical waveguide consisting of macromolecular core

(68a) and clad. The conductor sheet is then patterned to a defined shape to form an electrical wiring pattern.

DESCRIPTION - An INDEPENDENT CLAIM is also included for mixed-loading optical distribution line and electrical wiring multilayer substrate manufacturing method.

USE - For manufacturing mixed-loading optical distribution line and electrical wiring multilayer sheet.

ADVANTAGE - The production of multilayer sheet of mixed-loading optical distribution line of large area is potentiated and the productivity is improved markedly.

DESCRIPTION OF DRAWING(S) - The figure explains the manufacturing process of multilayer sheet. (Drawing includes non-English language text).

Core (68a)

CHOSEN-DRAWING: Dwg.3/12

TITLE-TERMS: MIX LOAD ELECTRIC WIRE OPTICAL DISTRIBUTE LINE MULTILAYER SHEET MANUFACTURE PATTERN CONDUCTOR BOND ONE SURFACE WAVEGUIDE FORM

DERWENT-CLASS: P81 V07

EPI-CODES: V07-F01A5;

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: 2002-102040

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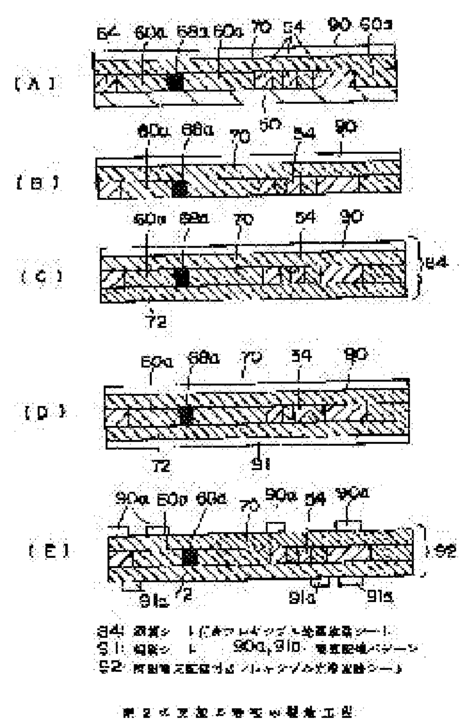
(71)Applicant : OKI PRINTED CIRCUIT KK
OKI ELECTRIC IND CO LTD

(72)Inventor : SHISHIDO KIKUO
FUJIMAKI SHO
SUZUKI MASAHIKO
MITA MITSURO
KAMIKAWA SHINKO
MAENO KIMINORI
MIYAMOTO HIROO

(54) METHOD FOR MANUFACTURING ELECTRIC WIRING/OPTICAL WIRING COEXISTING MULTILAYER SHEET AND METHOD FOR MANUFACTURING ELECTRIC WIRING/OPTICAL WIRING COEXISTING MULTILAYER SUBSTRATE



(57)Abstract:

PROBLEM TO BE SOLVED: To manufacture an electric wiring/optical wiring coexisting multilayer sheet having a large area.

SOLUTION: Electric wiring 54 made of a Cu thick film is provided on a substrate 50. Further, intermediate clad 60a, a core 68a and an upper clad layer 70 all consisting of high polymer material are provided and a copper foil sheet 90 is stuck onto the upper clad layer. Thereafter, the substrate is removed and a lower clad layer 72 is formed in a place where the substrate has existed. Next, after sticking the copper foil sheet 91 onto the lower clad layer, the electric wiring/optical wiring coexisting multilayer sheet wherein electric wiring 90a, 91a is formed on both of upper and lower surfaces of a flexible

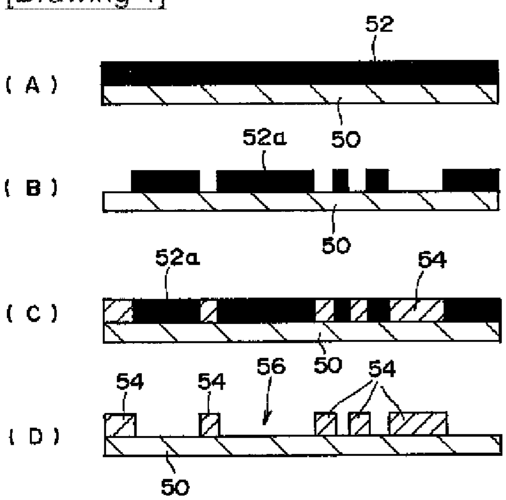
optical waveguide sheet incorporating electric wiring 54 by patterning theses copper foil sheets 90, 91 and forming electric wiring 90a, 91a is manufactured.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

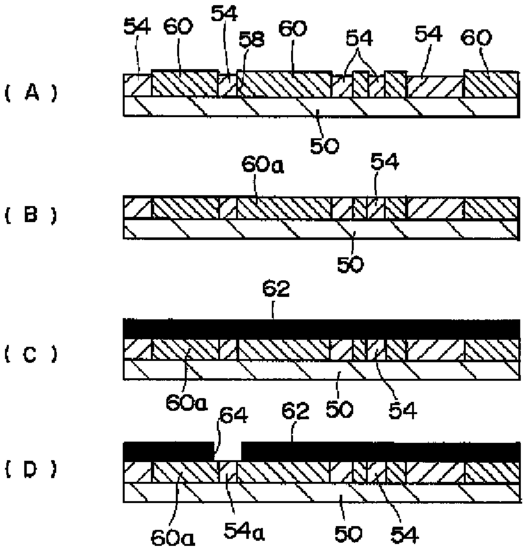
[Drawing 1]



50: 基板 52,52a: ドライフィルム
54: Cu 厚膜 56: 凹凸構造

第1の実施の形態の製造工程（その1）

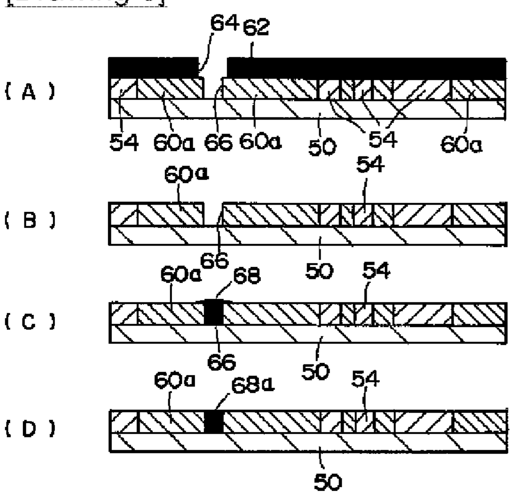
[Drawing 2]



58: 凹部　60: フッ素化ポリイミド膜
60a: 中間クラッド層　62: ドライフィルム
64: 開口部

第１の実施の形態の製造工程（その２）

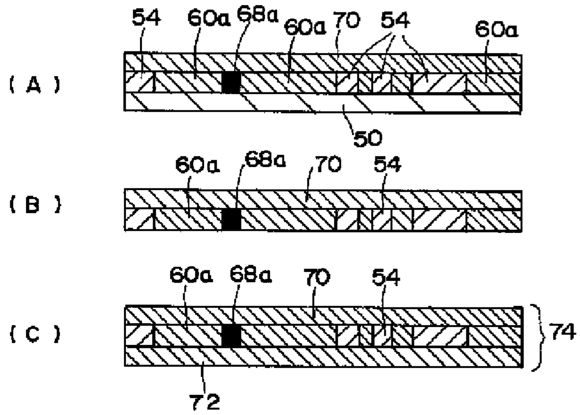
[Drawing 3]



66：Cu 厚膜の除去部分
68：フッ素化ポリイミド膜
68a：コア

第１の実施の形態の製造工程（その３）

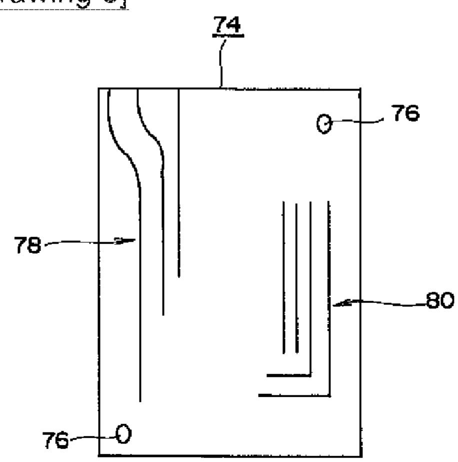
[Drawing 4]



70: 上部クラッド層
72: 下部クラッド層
74: フレキシブル光導波路シート

第1の実施の形態の製造工程（その4）

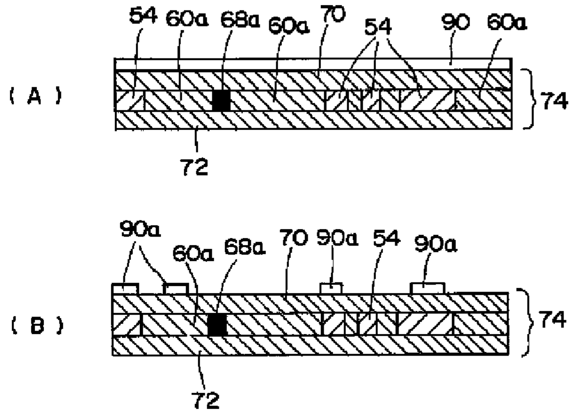
[Drawing 5]



74: 電気配線内在フレキシブル光導波路シート
76: 位置合せ用マーク
78: 光導波路部
80: 電気配線部

電気配線内在フレキシブル光導波路シートの構成の一例

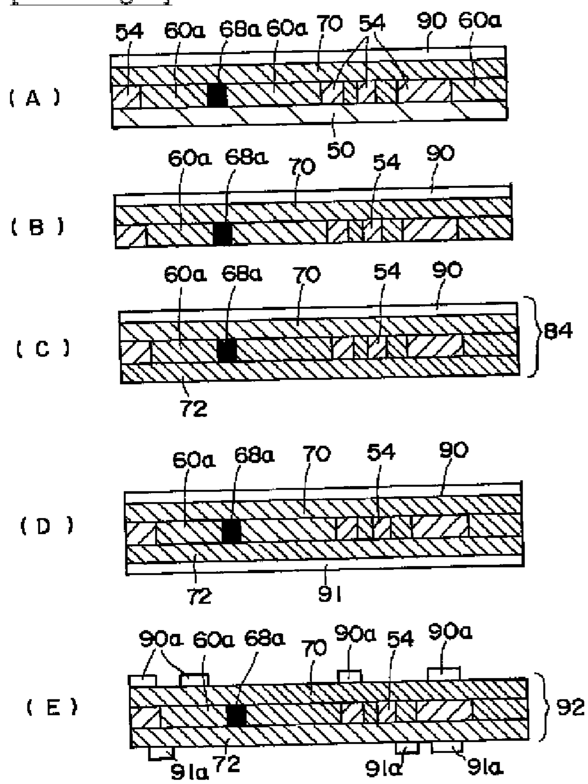
[Drawing 6]



90： 銅箔シート
90a：電気配線パターン

第１の実施の形態の製造工程（その５）

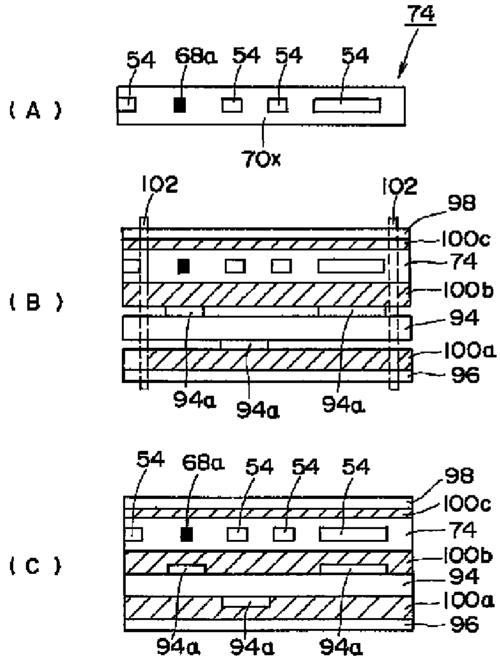
[Drawing 7]



84: 銅箔シート付きフレキシブル光導波路シート
91: 銅箔シート　90a,91a: 電気配線パターン
92: 両面電気配線付きフレキシブル光導波路シート

第２の実施の形態の製造工程

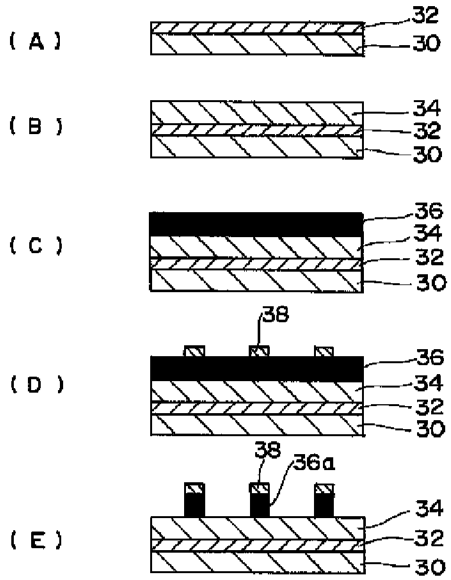
[Drawing 8]



54：電気配線　68a：コア
70x：クラッド　74：光導波路シート
94：プリント基板
94a：プリント基板上の電気配線
96,98：銅箔シート
100a,100b,100c：プリプレグ
102：ピン

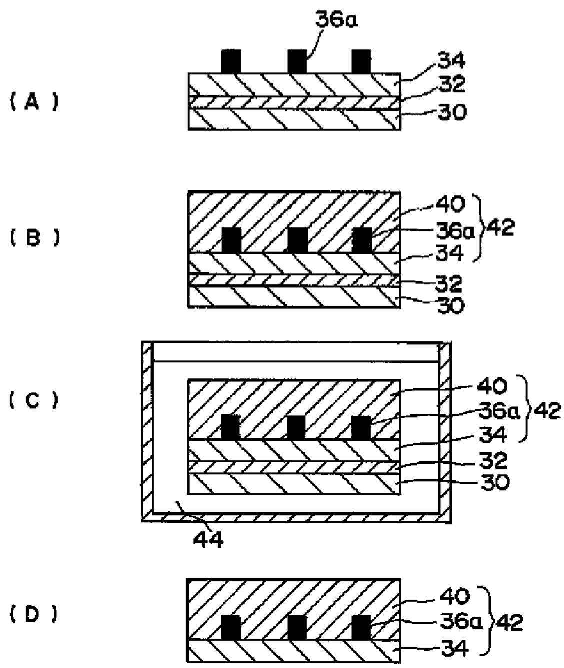
第３の実施の形態の製造工程（その１）

[Drawing 11]



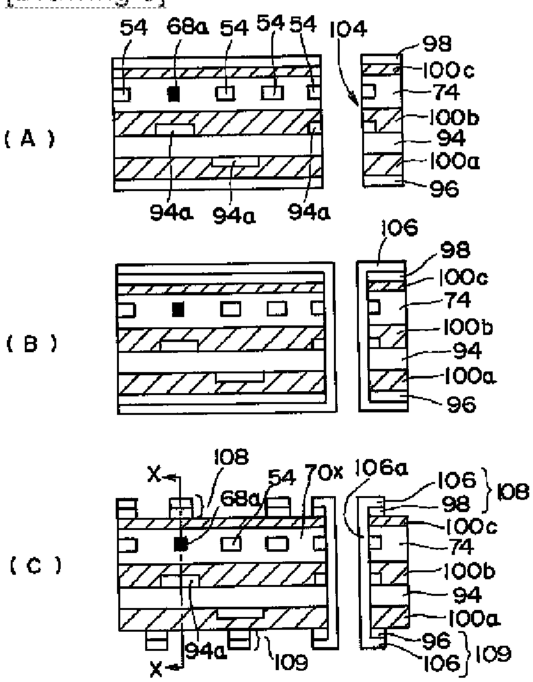
従来の製造工程（その１）

[Drawing 12]



従来の製造工程（その２）

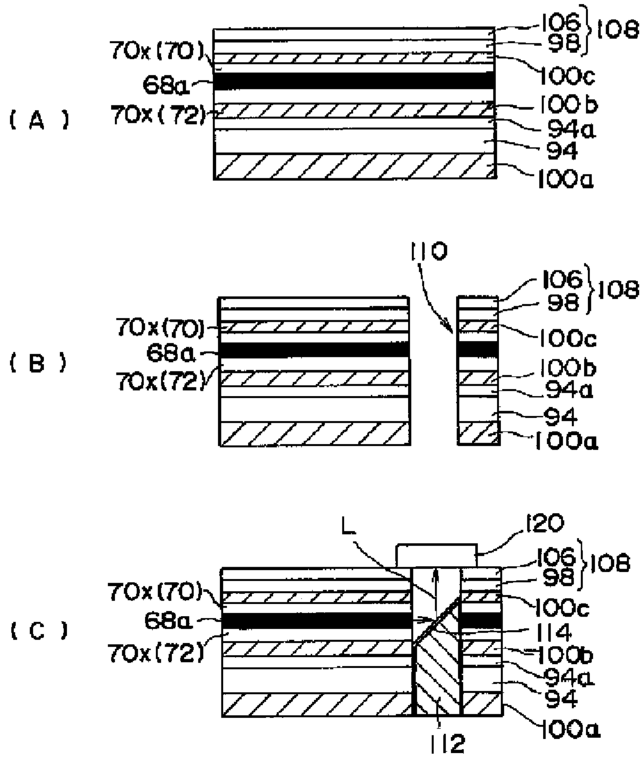
[Drawing 9]



104：スルーホール
106：メッキ層
106a：スルーホール・メッキ部
108,109：電気配線パターン

第５の実施の形態の製造工程（その２）

[Drawing 10]



110：開口部
112：90° 偏光ミラー(114：ミラー部)
120：受光素子

第 4 の 実 施 の 形 態 の 製 造 工 程

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is used for optical INTAKONEKUTO and relates to the manufacturing method of suitable electric wiring and optical wiring mixed-loading multilayered sheet, and the manufacturing method of electric wiring and an optical wiring mixed-loading multilayer substrate.
[0002]
[Description of the Prior Art]Conventionally, the printed circuit board in which electrical parts, such as IC and resistance, were carried carried only the electrical part chiefly, and transfer of the signal between printed circuit boards and in an inter module has been performed by the flexible electrical cable. However, these days, not only an electrical part but the optical component is loaded together more often on the same printed circuit board, and optical wiring, such as an optical fiber, is also used with electric wiring within such a printed circuit board. And transfer of the signal between printed circuit boards and in an inter module is also increasingly performed using a flexible optical fiber.
[0003]Thus, according to optical INTAKONEKUTO which delivers and receives the signal by light, delay more nearly time than the case of only electric wiring becomes small, and improvement in the speed of signal processing can be realized. There is an advantage of not being influenced by the electrical noise which poses a problem by electric wiring in optical INTAKONEKUTO. Therefore, optical INTAKONEKUTO will be increasingly used abundantly from now on, and not only the performance and reliability but low cost-ization becomes important after this.
[0004]Conventionally, the optical waveguide which has the flexibility constituted from a polymer material as parts of optical fiber cable for optical INTAKONEKUTO is used, and the manufacturing method is indicated by literature "JP,8-304650,A."

[0005]With reference to drawing 11 and drawing 12, it explains about the manufacturing method indicated by the above-mentioned literature. Drawing 11 and drawing 12 are the sectional views showing the conventional manufacturing process.
[0006]First, the copper (Cu) thin film 32 tens of nm - hundreds of nm thick is formed by sputtering on Si substrate 30 (drawing 11 (A)).
[0007]Next, a polymers optical waveguide material is deposited on Cu thin film 32, and the lower clad layer 34 is formed (drawing 11 (B)).
[0008]Next, a polymers optical waveguide material is deposited on the lower clad layer 34, and the core layer 36 is formed (drawing 11 (C)). The refractive index of this core layer 36 has adjusted material so that it may become higher than the refractive index of the lower clad layer 34.
[0009]Next, after applying resist on the core layer 36, photo lithography and development are performed and the resist pattern 38 is formed on the core layer 36 (drawing 11 (D)).
[0010]Next, reactive ion etching (RIE) using oxygen (O_2) gas is performed, the core layer 36 is patterned, and the core 36a of the pattern corresponding to the resist pattern 38 is formed (drawing 11 (E)).
[0011]Next, the resist pattern 38 on the core 36a is removed (drawing 12 (A)).
[0012]Next, on the portion and the core 36a which the lower clad layer 34 has exposed, a polymers optical waveguide material is deposited and the upper clad layer 40 is formed (drawing 12 (B)). It is made for the refractive index of the part cladding layer 40 to become the same as the refractive index of the lower clad layer 34 besides. Of the above process, the optical waveguide part 42 constituted by the upper clad layer 40, the core 36a, and the lower clad layer 34 is formed on Cu thin film 32.
[0013]Next, chloride (HCl) solution or the potassium hydrate (KOH) solution 44 is made to immerse an optical waveguide chip (drawing 12 (C)), Cu thin film 32 is melted, and the optical waveguide part 42 is exfoliated from Si substrate 30 (drawing 12 (D)). As a result, the optical waveguide part 42 which exfoliated is obtained as a flexible optical waveguide.
[0014]
[Problem(s) to be Solved by the Invention]However, according to the manufacturing method indicated by the above-mentioned literature, the process (drawing 11 (A)) of forming Cu thin film 32, and the RIE process (drawing 11 (E)) serve as a vacuum process performed within a vacuum chamber. Thus, vacuum devices are needed by the conventional method. Generally, vacuum devices are expensive and a vacuum process reduces productivity. Therefore, low-cost-izing is difficult.
[0015]moreover -- there is usually a limit in the size of a vacuum chamber -- the field of the thickness of the Cu thin film on a substrate, or the process tolerance of RIE -- internal division -- the size of the substrate which can be processed has a limit also from a point of cloth. For

this reason, according to the conventional method, the optical waveguide of a size called a several 10-cm angle was not able to be produced, for example. When it was going to use for optical INTAKONEKUTO the optical waveguide sheet which consists of the conventional flexible optical waveguide, there was a problem in respect of the flexibility of (1) electric wiring and optical wiring, and the densification of mounting of (2) electrical parts and an optical component.

[0016]This invention solves the above-mentioned problem, and its vacuum devices are unnecessary and, moreover, it enables manufacture of the optical waveguide which can produce the optical waveguide of a large area, It aims at providing the manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet and the manufacturing method of electric wiring and an optical wiring mixed-loading multilayer substrate which furthermore made possible flexibility of electric wiring and optical wiring, and densification of mounting of an electrical part and an optical component.

[0017]

[Means for Solving the Problem]This invention is characterized by a manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet comprising the following, in order to solve an aforementioned problem.

A process of pasting a conductor seat together on the surface of a flexible optical waveguide sheet provided with an optical waveguide which consists of a core and a clad which were formed with a polymer material, and at least one field on the back.

A process of patterning said conductor seat after predetermined shape, and forming a pattern of electric wiring.

[0018]It is preferred to face to manufacture electric wiring and an optical wiring mixed-loading multilayered sheet, and to make a pattern of electric wiring further inherent for multilayering of electric wiring in a flexible optical waveguide sheet.

[0019]Face manufacturing electric wiring and an optical wiring mixed-loading multilayered sheet, and for multilayering of electric wiring, It is preferred to form a pattern of electric wiring in both sides of said flexible optical waveguide sheet in said process of pasting a conductor seat together to the surface of said flexible optical waveguide sheet and both sides on the back in said process of pasting a conductor seat together, and forming a pattern of electric wiring.

[0020]In order to face manufacturing said electric wiring and optical wiring mixed-loading multilayered sheet and to improve adhesion between layers, It is preferred to have further a process of carrying out roughening treatment of each field of said flexible optical waveguide sheet and said conductor seat to paste together beforehand, before said process of pasting a conductor seat together.

[0021]It is preferred to have further a process of facing manufacturing electric wiring and an

optical wiring mixed-loading multilayered sheet, forming a through hole or a beer hall in said flexible optical waveguide sheet for an interlayer connection, and plating a conductor to a wall of the through hole concerned or a beer hall.

[0022]In order to face manufacturing electric wiring and an optical wiring mixed-loading multilayered sheet and to plan optical coupling of an optical waveguide and an optical component, A process of providing an opening in said flexible optical waveguide sheet so that an opening may be carried out including a position in the core formation area, It is located in a process of mounting a deflection mirror in the opening concerned, and the upper part of said deflection mirror, It is preferred to have further a process of being mounted in the surface of said flexible optical waveguide sheet or one field of on the back, and mounting an optical component in which a core and optical coupling of said optical waveguide are planned via said deflection mirror.

[0023]A manufacturing method of electric wiring and an optical wiring mixed-loading multilayer substrate concerning this invention is provided with the following.

A flexible optical waveguide sheet provided with an optical waveguide which consists of a core and a clad which were formed with a polymer material.

A process of pasting together and laminating a printed circuit board which has electric wiring via prepreg, and pasting together and laminating a conductor seat to a field where an opposed face with another side in either [at least] said flexible optical waveguide sheet or said printed circuit boards is opposite.

A process of patterning said conductor seat after predetermined shape, and forming a pattern of electric wiring.

[0024]In said process of facing manufacturing electric wiring and an optical wiring mixed-loading multilayer substrate, and pasting together and laminating a conductor seat, it is preferred that said conductor seat pastes together and is laminated via prepreg.

[0025]It is preferred to face to manufacture electric wiring and an optical wiring mixed-loading multilayer substrate, and to make a pattern of electric wiring further inherent for multilayering of electric wiring in said flexible optical waveguide sheet.

[0026]Face manufacturing electric wiring and an optical wiring mixed-loading multilayer substrate, and for multilayering of electric wiring, In said process of pasting together and laminating a conductor seat, to a field opposite to a field where said flexible optical waveguide sheet and said printed circuit board counter mutually. In said process of pasting together and laminating a conductor seat via prepreg, respectively, and forming a pattern of electric wiring, It is preferred to pattern a conductor seat laminated, respectively and to form electric wiring via said prepreg, on said flexible optical waveguide sheet and said printed circuit board.

[0027]In order to face manufacturing electric wiring and an optical wiring mixed-loading

multilayer substrate and to improve adhesion between layers, Before said process of pasting together and laminating a flexible optical waveguide sheet and a printed circuit board via prepreg, and pasting together and laminating a conductor seat, It is preferred to have further said flexible optical waveguide sheet, said printed circuit board, and a process of carrying out roughening treatment of each field of said conductor seat to paste together beforehand.
[0028]Face manufacturing electric wiring and an optical wiring mixed-loading multilayer substrate, and for an interlayer connection, A through hole or a beer hall is formed in a layered product formed of said process of pasting together and laminating a flexible optical waveguide sheet and a printed circuit board via prepreg, and pasting together and laminating a conductor seat, It is preferred to equip further a wall of the through hole concerned or a beer hall with a process of plating a conductor.
[0029]In order to face manufacturing electric wiring and an optical wiring mixed-loading multilayer substrate and to plan optical coupling of an optical waveguide and an optical component, A process of providing an opening so that an opening may be carried out including a position in a core formation area of said flexible optical waveguide sheet in a layered product formed from performing each process of the invention according to claim 7, It is preferred to have further a process of mounting a deflection mirror in the opening concerned, and a process of being located above said deflection mirror, being mounted in the surface of said layered product or one field of on the back, and mounting an optical component in which a core and optical coupling of said optical waveguide are planned via said deflection mirror.
[0030]
[Embodiment of the Invention]Hereafter, with reference to figures, it explains per this embodiment of the invention. The figure only shows shape, a size, and arrangement relationship roughly to such an extent that it can understand this invention. Conditions, materials, etc., such as a numerical value indicated below, are only mere examples, and this invention is not limited to this embodiment at all.
[0031][A 1st embodiment] in this 1st embodiment. The manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet, and the flexible optical waveguide sheet (electric wiring and optical wiring mixed-loading multilayered sheet) of the multilayer structure which specifically provided electric wiring further on the upper clad layer of the flexible optical waveguide sheet which is inherent in electric wiring is explained. With reference to drawing 1 - drawing 6, it explains about the manufacturing process of this 1st embodiment. First, the flexible optical waveguide sheet which made electric wiring inherent in a flexible optical waveguide sheet is manufactured. Drawing 1 - drawing 4 are the sectional views showing the manufacturing process of this flexible optical waveguide sheet. The composition of the principal part is shown in each figure.
[0032]First, the dry film 52 which is a photosensitive resin film is laminated on the upper

surface of the substrate 50 (drawing 1 (A)). The substrate 50 is a product made from stainless steel (SUS). as the dry film 52 -- AQ1 by Asahi Chemical Industry Co., Ltd. -- 5036 (part number) is used. The sizes of the dry film 52 are 200 mm squares. The thickness of the dry film 52 is 50 micrometers.

[0033]Then, UV irradiation is carried out to the dry film 52 using an exposure mask with the opening pattern having the pattern of a core and electric wiring. The dry film 52 which formed the latent image in the dry film 52, then was exposed by this is developed. As a result, the position of the dry film 52 is removed and the dry film 52a which makes a removal section a crevice is obtained on the substrate 50 (drawing 1 (B)). The pattern of the dry film 52a which remained is in agreement with the pattern of an intermediate cladding layer.

[0034]Next, the copper (Cu) thick film 54 is about formed in a thickness of about 50 micrometers with an electroplating method so that the crevice of the dry film 52a may be filled (drawing 1 C). The pattern of the Cu thick film 54 is in agreement with the pattern of a core and electric wiring. Then, the rugged structure 56 by which the pattern of the Cu thick film 54 was formed in the position on the Cu board 50 is acquired by being immersed in sodium hydroxide solution 3%, and exfoliating the dry film 52a (drawing 1 (D)). This rugged structure 56 serves as a mold of an intermediate cladding layer.

[0035]Here, roughening treatment of the surface of the Cu thick film 54 is performed. In this roughening treatment, the copper surface is oxidized and minute unevenness and needlelike projection are formed in that surface. By this unevenness and small projected part, the resin formed in the circumference of the Cu thick film 54 becomes that it is easy to be fixed.

[0036]Next, the solution (Hitachi Chemical 3205 [OPI N-] (product name)) of fluorinated polyimide which is a clad material is slushed into the crevice 58 of the produced rugged structure 56 with screen printing, and heat treatment of 1 hour is performed at the temperature of 350 **. Volatilization of the solvent of a fluorinated polyimide solution and imide-ization arise, and the fluorinated polyimide film 60 is formed in the crevice 58 by this calcination (drawing 2 (A)). Since a volumetric shrinkage happens in the case of imide-izing, he performs casting of a solution, and calcination repeatedly in 3 steps, and is trying to obtain the fluorinated polyimide film 60 of thickness eventually somewhat thicker than 50 micrometers.

[0037]Then, grind the surface of the fluorinated polyimide film 60 and the Cu thick film 54 so that dimensional accuracy required as an optical waveguide may be acquired, and flattening of those surfaces is carried out, and it adjusts to a thickness of about 50 micrometers. The fluorinated polyimide film after this polish serves as the intermediate cladding layer 60a. (drawing 2 (B)).

[0038]Next, the dry film 62 is laminated on the upper surface of the intermediate cladding layer 60a which carried out flattening by polish, and the Cu thick film 54 (drawing 2 (C)). Then, the portion of the dry film 62 of the Cu thick film 54a upper part in the position which is due to form

a core is removed (drawing 2 (D)). For this reason, exposure and development remove the removed region of the dry film 62. Thereby, the opening 64 is formed in the portion of the dry film 62 located in the Cu thick film 54a upper part. Therefore, the upper surface of the Cu thick film 54a removed is exposed.

[0039]Next, the Cu thick film 54a which made the etching reagent immerse and was exposed by the previous process is removed (drawing 3 (A)). At this time, since it is protected by the dry film 62, other Cu thick films 54 are not removed. The dry film 62 which became unnecessary is exfoliated after the end of etching (drawing 3 (B)). The removal section 66 of the Cu thick film 54a serves as a mold of a core.

[0040]Next, core materials are injected into the removal section 66 of Cu thick film. As a polymer material for cores, the solution (Hitachi Chemical 3405 [OPI N-] (product name)) of fluorination BORIIMIDO whose fluorine content is smaller than a clad material is used. Thus, by lessening a fluorine content, the optical refractive index of a core becomes large compared with the refractive index of the intermediate cladding layer 60a. Like the formation process of the intermediate cladding layer 60a, after slushing the fluorinated polyimide solution of core materials into a prescribed part, heat treatment of 1 hour is performed at the temperature of 350 **. Since a volumetric shrinkage happens in the case of imide-izing as mentioned above, it is made to perform casting of a solution, and calcination repeatedly in 3 steps. And the fluorinated polyimide film 68 of thickness somewhat thicker than 50 micrometers is formed eventually (drawing 3 (C)).

[0041]Then, puff polish of the surface of the fluorinated polyimide film 68 is carried out so that dimensional accuracy required as an optical waveguide may be acquired, and it adjusts to a thickness of about 50 micrometers. The fluorinated polyimide film after this polish serves as the core 68a (drawing 3 (D)).

[0042]Here, roughening treatment of the upper surface by which the Cu thick film 54 was ground is performed. Then, the fluorinated polyimide solution (Hitachi Chemical 3205 [OPI N-] (product name)) of the same polymers optical waveguide material as the intermediate cladding layer 60a is applied to the upper surface of this Cu thick film 54, and the core 68a and the upper surface of the intermediate cladding layer 60a. And a 30-micrometer-thick fluorinated polyimide film is obtained as the upper clad layer 70 by performing heat treatment of 1 hour at the temperature of 350 ** to the applied solution (drawing 4 (A)).

[0043]Next, the substrate 50 is exfoliated mechanically (drawing 4 (B)). Then, roughening treatment is performed to the surface of the exposed Cu thick film 54. And the fluorinated polyimide solution (Hitachi Chemical 3205 [OPI N-] (product name)) of the same polymers optical waveguide material as the intermediate cladding layer 60a is applied to the portion which removed the substrate 50. Heat treatment of 1 hour is performed at the temperature of 350 ** to the applied fluorinated polyimide solution. A 30-micrometer-thick fluorinated polyimide

film is formed as the lower clad layer 72 by this calcination (drawing 4 (C)).

[0044]Thus, it has an optical waveguide (optical wiring) which consists of the upper clad, the middle clad, core, and lower clad which are shown in drawing 4 (C), and the electric wiring which consists of a Cu thick film, and the flexible optical waveguide sheet 74 in which this electric wiring was made inherent is formed.

[0045]Thus, in the flexible optical waveguide sheet 74 formed, Since Cu thick films, such as electric wiring, are made and put into a transparent optical waveguide sheet, as shown in drawing 5, the mark 76 for alignment by Cu thick film can be formed into the flexible optical waveguide sheet 74 of electric wiring immanency. Drawing 5 is a top view showing an example of the composition of the flexible optical waveguide sheet 74 of the electric wiring immanency produced. Into the flexible optical waveguide sheet 74 of this electric wiring immanency, the optical waveguide part 78 with a core and the electric wiring part 80 by Cu thick film are formed. The mark 76 for alignment is formed with Cu thick film. Thus, if the mark 76 for alignment is formed, since the optical waveguide itself is transparent, originally the difficult registration will become easy. For example, when pasting together the flexible optical waveguide sheet 74 of electric wiring immanency on a printed circuit board, it becomes possible to perform highly precise registration.

[0046]Subsequently, the formation process of the electric wiring to the flexible optical waveguide sheet surface of the electric wiring immanency produced at above-mentioned drawing 1 - the process of drawing 4 is explained with reference to drawing 6. First, roughening treatment of the surface of the upper clad layer 70 of the flexible optical waveguide sheet 74 of the electric wiring immanency produced at the above-mentioned process is performed. In this roughening treatment, surface roughening of the surface of the upper clad layer 70 is carried out with the roughening treatment method by a chemical treatment etc., and minute unevenness is formed in that surface. The copper foil sheet 90 of 20 micrometers of thickness is prepared as a conductor seat pasted together on the upper clad layer 70, and roughening treatment of the field pasted together to the upper clad layer 70 of this copper foil sheet 90 is carried out. In this roughening treatment, surface roughening is carried out with the roughening treatment method of oxidizing the copper surface, and minute unevenness and needlelike projection are formed in that surface.

[0047]Subsequently, it is made to make the lamination side where surface roughening of the copper foil sheet 90 was carried out counter the upper clad layer 70 surface by which surface roughening was carried out, After laying the copper foil sheet 90 on the upper clad layer 70, the copper foil sheet 90 and the upper clad layer 70 are pasted together by being stuck by pressure using heating and the crimp means which is not illustrated, heating (drawing 6 (A)). Since surface roughening of both sides pasted together as mentioned above is carried out, the lamination intensity of the copper foil sheet 90 and the upper clad layer 70 can be increased.

[0048]Subsequently, after applying and drying resist on the surface of the copper foil 90 pasted together to the upper clad layer 70, After forming the etching mask which is exposed using an exposure mask with a desired electric wiring pattern, develops negatives further, and consists of resist patterns, it is immersed in an etching reagent, The pattern of the electric wiring 90a which consists of copper is formed by dissolving and removing unnecessary copper foil and removing the etching mask which consists of resist further (drawing 6 (B)).
[0049]Thus, the flexible optical waveguide sheet of multilayer structure in which the electric wiring pattern 90a was formed in the flexible optical waveguide sheet 74 surface of electric wiring immanency is completed. Thus, high-density mounting is attained by mounting optical components, such as IC, other electrical parts, and a light receiving and emitting element, if needed on the flexible optical waveguide sheet of the formed multilayer structure, and making it connect with the electric wiring pattern of a sheet surface, etc. if needed. According to a design, formation of a beer hall, plating treatment of the surface, etc. are performed to an upper clad layer, and the surface arbitrary electric wiring 90a and the arbitrary electric wiring 54 made inherent in the optical waveguide sheet 74 can electrically be connected.
[0050]According to this embodiment, by excluding the vacuum process which uses the Cu thin film in the above-mentioned literature at the process formed by sputtering process, and the process of RIE, vacuum devices are written as it is unnecessary, and production of the flexible optical waveguide sheet of a large area is attained. since there is no vacuum process, productivity is markedly alike and improves, and since expensive vacuum devices are not used simultaneously, low cost-ization is attained.
[0051]Since it is considered as the multilayer structure which provided the pattern of electric wiring in the surface of the flexible optical waveguide sheet in which electric wiring was made inherent in this embodiment, (1) the increase of the flexibility of electric wiring and optical wiring, and (2) -- since a wire length can be shortened, the strength reduction of an electrical signal and a lightwave signal and delay can be reduced again, or the influence of a noise can be reduced, and densification of the mounting of (3) electrical parts and an optical component can be carried out.
[0052]Various modifications of this embodiment are explained below. First, although a core shows one example and the optical waveguide shows one example in this embodiment in the manufacturing process figure shown in drawing 1 - drawing 4, and drawing 6, According to a design, the number of cores, i.e., the number of optical waveguides, can be formed, and as shown also in drawing 5, it can be used as the flexible optical waveguide sheet provided with two or more optical waveguides.
[0053]Although this embodiment showed the example in which electric wiring was formed on that surface, by using as a base the flexible optical waveguide sheet in which electric wiring was made inherent, The flexible optical waveguide sheet used as this base may be a flexible

optical waveguide sheet of only the optical waveguide (optical wiring) which is not inherent in electric wiring.
[0054]In this embodiment, although the dry film 52 was patterned by exposure and development, this patterning may be performed with a laser ablation method. According to the laser ablation method, the dry film 52 can be patterned by irradiating with a laser beam. Therefore, it can pattern simpler.
[0055]Patterning by exposure and development and patterning by a laser ablation method may be used together. It compares, the small place of ** and pattern width is performed with a laser ablation method, and it is preferred for the large place of the other pattern width that exposure and development perform.
[0056]Although this embodiment showed the example which used fluorinated polyimide as a polymers optical waveguide material, it is also possible to use polymer materials, such as PMMA systems other than this, a silicone series, and a polycarbonate system. By the above-mentioned explanation, when patterning copper foil, the example using the etching mask by resist was shown, but it may replace with this and the etching mask which patterned this in exposure and development may be used using a dry film and photopolymers, such as photosensitive ink. Although the above-mentioned explanation showed the example in which the electric wiring which consists of copper only on the surface of an upper clad layer was formed, the same electric wiring may be formed on the surface of a lower clad layer, and electric wiring may be further formed in both the upper clad layer surface and the lower clad layer surface.
[0057][A 2nd embodiment] Next, the electric wiring and the optical wiring mixed-loading multilayered sheet of a 2nd embodiment of this invention are explained with reference to figures. Although a 1st above-mentioned embodiment explained the manufacturing method of the flexible optical waveguide sheet of the multilayer structure which provided electric wiring on the upper clad layer of the flexible optical waveguide sheet which is inherent in electric wiring, A manufacturing method of the flexible optical waveguide sheet (electric wiring and optical wiring mixed-loading multilayered sheet) of the multilayer structure which provided electric wiring in this 2nd embodiment on the upper clad layer of the flexible optical waveguide sheet which is inherent in electric wiring, and the lower clad layer, That is, the manufacturing method of the flexible optical waveguide sheet of the multilayer structure which provided electric wiring in the upper surface of the flexible optical waveguide sheet of electric wiring immanency and both sides at the bottom is explained with reference to drawing 7. The same number is attached and explained about the same composition as a 1st embodiment.
[0058]In this 2nd embodiment, a process, the material to be used, etc. until it forms the upper clad layer 70 are performed like a 1st above-mentioned embodiment. Therefore, although the detailed explanation about a process until it forms this upper clad layer 70 is omitted,

explanation and the drawing of a 1st embodiment are hereafter applied and explained about the outline of the process to upper clad layer 70 formation.
[0059]First, the formation of the rugged structure 56 and the roughening treatment of Cu thick film surface which consist of the Cu thick film 54 to the SUS substrate 50 top are performed like the process explained with reference to drawing 1 (A) - (D) in a 1st above-mentioned embodiment. Subsequently, the intermediate cladding layer 60a is formed like the process explained with reference to drawing 2 (A) of a 1st embodiment, and (B). Subsequently, the core 68a is formed like the process explained with reference to drawing 2 (C) of a 1st embodiment, (D), and drawing 3 (A) - (D). Subsequently, the upper clad layer 70 is formed like the process explained with reference to drawing 4 (A) of a 1st embodiment. Besides, the process to formation of the part cladding layer 70 is the same as that of a 1st embodiment as mentioned above, and the process after this differs from a 1st embodiment.
[0060]Then, roughening treatment of the surface of the upper clad layer 70 is performed. In this roughening treatment, surface roughening of the surface of the upper clad layer 70 is carried out with the roughening treatment method by a chemical treatment etc., and minute unevenness is formed in that surface. The copper foil sheet 90 of 20 micrometers of thickness is prepared as a conductor seat pasted together on the upper clad layer 70, and roughening treatment of the field pasted together to the upper clad layer 70 of this copper foil sheet 90 is carried out. In this roughening treatment, surface roughening is carried out with the roughening treatment method of oxidizing the copper surface, and minute unevenness and needlelike projection are formed in that surface. Subsequently, it is made to make the lamination side where surface roughening of the copper foil sheet 90 was carried out counter on the upper clad layer 70 surface by which surface roughening was carried out, After laying the copper foil sheet 90 on the upper clad layer 70, the copper foil sheet 90 and the upper clad layer 70 are pasted together by being stuck by pressure using heating and the crimp means which is not illustrated, heating (drawing 7 (A)). Since surface roughening of both sides pasted together as mentioned above is carried out, the lamination intensity of the copper foil sheet 90 and the upper clad layer 70 can be increased. [0061]Next, the substrate 50 is exfoliated mechanically (drawing 7 (B)). Then, roughening treatment is performed to the surface of the exposed Cu thick film 54. And the fluorinated polyimide solution (Hitachi Chemical 3205 [OPI N-] (product name)) of the same polymers optical waveguide material as the intermediate cladding layer 60a is applied to the portion which removed the substrate 50. Heat treatment of 1 hour is performed at the temperature of 350 ** to the applied fluorinated polyimide solution. A 30-micrometer-thick fluorinated polyimide film is formed as the lower clad layer 72 by this calcination (drawing 7 (C)). Thereby, the flexible optical waveguide sheet 84 of electric wiring immanency in which the copper foil sheet was stuck on the upper clad layer surface is done.
[0062]Subsequently, the copper foil sheet to the lower clad layer 72 surface of the flexible

optical waveguide sheet 84 produced as mentioned above is stuck. In advance of it, roughening treatment of the surface of the lower clad layer 72 is performed first. In this roughening treatment, surface roughening of the surface of the lower clad layer 72 is carried out with the roughening treatment method by a chemical treatment etc., and minute unevenness is formed in that surface. The copper foil sheet 91 of 20 micrometers of thickness pasted together on the lower clad layer 72 is prepared, and roughening treatment of the field pasted together to the lower clad layer 72 of this copper foil sheet 91 is carried out. In this roughening treatment, surface roughening is carried out with the roughening treatment method of oxidizing the copper surface, and minute unevenness and needlelike projection are formed in that surface.

[0063]Subsequently, it is made to make the lamination side where surface roughening of the copper foil sheet 91 was carried out counter the lower clad layer 72 surface by which surface roughening was carried out, After laying the copper foil sheet 91 on the lower clad layer 72, the copper foil sheet 91 and the lower clad layer 72 are pasted together by being stuck by pressure using heating and the crimp means which is not illustrated, heating (drawing 7 (D)). Since surface roughening of both sides pasted together as mentioned above is carried out, the lamination intensity of the copper foil sheet 91 and the lower clad layer 72 can be increased.

[0064]Subsequently, after applying and drying resist, respectively on the surface of the copper foil sheet 91 pasted together to the surface and the lower clad layer 72 of the copper foil sheet 90 pasted together to the upper clad layer 70, After forming the etching mask which is exposed using an exposure mask with a desired electric wiring pattern, develops negatives further, and consists of resist patterns, it is immersed in an etching reagent, The pattern of the electric wiring 90a and 91a which consists of copper, respectively is formed on the upper clad layer 70 and the lower clad layer 72 by dissolving and removing unnecessary copper foil and removing the etching mask which consists of resist further (drawing 7 (E)).

[0065]Thus, the flexible optical waveguide sheet 92 of multilayer structure in which the electric wiring patterns 90a and 91a were formed in the upper surface of the flexible optical waveguide sheet of electric wiring immanency and both sides at the bottom is completed. Thus, high-density mounting is attained by mounting optical components, such as IC, other electrical parts, and a light receiving and emitting element, if needed on the flexible optical waveguide sheet of the formed multilayer structure, and making it connect with the electric wiring pattern of a sheet surface, etc. if needed. . [whether according to a design, the through hole penetrated on the undersurface from the upper surface of a flexible optical waveguide sheet is formed, and] Or form a beer hall in an upper clad layer or a lower clad layer, and plating treatment of the wall surface of a through hole or a beer hall, etc. are performed, The arbitrary electric wiring (Cu thick film pattern) 54 made inherent in the arbitrary electric wiring 90a, or 91a and flexible optical waveguide sheets of a flexible optical waveguide sheet upper surface

or the undersurface can electrically be connected.
[0066]According to this embodiment, by excluding the vacuum process which uses the Cu thin film in the above-mentioned literature at the process formed by sputtering process, and the process of RIE, vacuum devices are written as it is unnecessary, and production of the flexible optical waveguide sheet of a large area is attained. since there is no vacuum process, productivity is markedly alike and improves, and since expensive vacuum devices are not used simultaneously, low cost-ization is attained.
[0067]In this embodiment, since SUS substrate 50 exists when sticking a copper foil sheet on an upper clad layer, when pasting copper foil together by heating and sticking by pressure, camber and a deflection are small to the whole layered product containing a substrate and others, and it becomes easier to paste copper foil together. When pasting a copper foil sheet together on a lower clad layer, the copper foil sheet pasted together on the upper clad layer plays the role of a reinforcement body before that, and also in this case, camber and a deflection are small to the whole layered product, and it becomes easy to paste copper foil together.
[0068]Since it is considered as the multilayer structure which provided the pattern of electric wiring in both sides of the flexible optical waveguide sheet in which electric wiring was made inherent in this embodiment, (1) the increase of the flexibility of electric wiring and optical wiring, and (2) -- since a wire length can be shortened, the strength reduction of an electrical signal and a lightwave signal and delay can be reduced again, or the influence of a noise can be reduced, and densification of the mounting of (3) electrical parts and an optical component can be carried out. Also in the manufacturing method of this 2nd embodiment, various modifications explained by a 1st embodiment can be applied.
[0069][A 3rd embodiment] In 1st and 2nd above-mentioned embodiments, fundamentally, although the pattern of electric wiring was added to the surface of one of the two of the flexible optical waveguide sheet of electric wiring immanency, or both surfaces by the lamination and patterning of the copper foil sheet, In this 3rd embodiment, the printed circuit board of only the conventional electric wiring, The manufacturing method of the electric wiring and the optical wiring mixed-loading multilayer substrate which pastes together and produces the flexible optical waveguide sheet of the electric wiring immanency produced at the process of drawing 1 - drawing 4 in a 1st above-mentioned embodiment is explained with reference to drawing 8 and drawing 9.
[0070]One flexible optical waveguide sheet of the electric wiring immanency as an example in this embodiment, It describes about the manufacturing method of the multilayer substrate of electric wiring and optical wiring mixed loading as for which one printed circuit board with double-sided electric wiring has further one layer of electric wiring, and the structure which laminated one layer of electric wiring under the printed circuit board above an optical

waveguide sheet. in this case, if the thing made inherent in an optical waveguide sheet as electric wiring is also included, it will all come out and will become five layers, but it is not limited to using in the form where each layer was separated, but has the structure of performing the interlayer connection between the electric wiring of a different layer according to a design. Hereafter, it explains in detail, referring to drawing 8 (A) - (C) and drawing 9 (A) - (C).

[0071]First, the flexible optical waveguide sheet which is inherent in electric wiring is produced. Although that concrete explanation is omitted about the manufacturing process of the flexible optical waveguide sheet of this electric wiring immanency, It is produced by the manufacturing process explained in detail in a 1st above-mentioned embodiment with reference to drawing 1 - drawing 4 (namely, drawing 1 (A) - (D), drawing 2 (A) - (D) drawing 3 (A) - (D) and drawing 4 (A) - (C)). The structure serves as the flexible optical waveguide sheet 74 of the electric wiring immanency shown in above-mentioned drawing 4 (C). In drawing 8 (A) used for explanation of this embodiment, although the classification of each cladding layer is omitted, a concrete structure is as the structure of above-mentioned drawing 4 (C). As shown in this drawing 8 (A) the flexible optical waveguide sheet 74 of electric wiring immanency, The clad 70x (this clad 70x shall consist of the upper clad layer 70, the intermediate cladding layer 60a, and the lower clad layer 72, and shall name these generically), the core 68a, and the electric wiring 54 that comprises copper are comprised. Although the graphic display has not been carried out, the mark 76 for alignment by Cu thick film is made to form into this flexible optical waveguide sheet 74, as explained using drawing 5.

[0072]Next, roughening treatment on the upper clad layer surface of the flexible optical waveguide sheet 74 of electric wiring immanency and the surface of a lower clad layer produced by doing in this way is performed. In this roughening treatment, surface roughening of the surface of an upper clad layer and a lower clad layer is carried out with the roughening treatment method by a chemical treatment etc., and minute unevenness is formed in that surface. Drawing 8 (A) shall show the flexible optical waveguide sheet 74 after this roughening treatment, although the surface surface roughening state has not carried out the graphic display clearly.

[0073]Similarly, about the printed circuit board 94 with double-sided electric wiring of one sheet, and the copper foil sheets 96 and 98 of two sheets, when laminating, roughening treatment of the surface contacted with other members is performed. The alignment mark is beforehand formed in the position corresponding to the alignment mark 76 of the flexible optical waveguide sheet 74 also at these printed circuit board 94 and copper foil sheets 96 and 98, respectively. When laminating furthermore, the same alignment mark is formed also in the prepregs 100a, 100b, and 100c of three sheets inserted between each class for an interlayer connection. And the printed circuit board 94 and the copper foil sheets 96 and 98 in which the

electric wiring 94a which consists of the flexible optical waveguide sheet 74 and copper was formed in both sides, the prepreg 100a, To each of 100b and 100c, each alignment mark is irradiated with a laser beam, and the circular hole of a predetermined path is formed. Using the circular pin 102 of the almost same path as the bore diameter of this hole, subsequently, the copper foil sheet 96, the prepreg 100a, It laminates by letting the hole established in each pass at the pin 102 in order of the printed circuit board 94, the prepreg 100b, the flexible optical waveguide sheet 74, the prepreg 100c, and the copper foil sheet 98, performing alignment of each member (drawing 8 (B)).

[0074]Subsequently, where each above-mentioned member is laminated, after removing the pin 102, by being stuck by pressure using heating and the crimp means which is not illustrated, heating, each laminated above-mentioned members are pasted together and a layered product is formed (drawing 8 (C)). The prepregs 100a, 100b, and 100c are what glass fiber was impregnated with the epoxy resin and dried, and by putting this between each class and carrying out heat crimping, can give and paste sufficient intensity together because resin hardens.

[0075]Subsequently, in a layered product, the cylindrical through hole 104 is formed, for example by processing the position which takes electrical coupling by the electric wiring between different layers with a carbide drill (drawing 9 (A)). This drawing 9 (A) shows the sectional view in the position in which the through hole 104 was formed. Since resin may adhere to the wall which punctured on the occasion of through hole 104 formation, in order to remove it, fault manganese desmear treatment is performed. In order to improve the adhesion of the chemicals coppering of a next process, roughening treatment of the field which fluorinated polyimide has exposed in the through hole 104 is performed. This roughening treatment carries out surface roughening of the above-mentioned exposed surface with the roughening treatment method by a chemical treatment etc., and forms minute unevenness in that surface.

[0076]After this roughening treatment, in order to give conductivity to the wall of the portion which carried out the opening of the through hole 104, non-electrolytic copper plating is performed into the portion which resin has exposed, and electrolytic copper plating is performed further. The through hole plated section which consists of about 0.5-micrometer non-electrolytic copper metal skin and an electroplated layer (several micrometers - tens of micrometers) is formed by this, and the mutual electrical link between the predetermined electric wiring of the surface and a rear face and the predetermined electric wiring of each class can be performed certainly (drawing 9 (B)). Drawing 9 (B) shows the section of the same position as drawing 9 (A), with this figure, mixes an electroless deposition layer and an electroplated layer, and shows them as the metal skin 106.

[0077]In this metal skin 106, the portion formed near [that] the wall of the through hole 104

and the substrate face serves as the through hole plated section 106a. Although there is a problem a little in respect of a cost aspect and reliability in non-electrolytic copper plating, since electrolytic copper plating is performed further, coppering can be performed certainly, and it can be considered as sufficient thickness. When performing non-electrolytic copper plating and plating by electroplating, the metal skin 106 of the copper same also on the copper foil sheet 98 of the top layer of a layered product and the copper foil sheet 96 of the bottom of the heap is formed, and the thickness of copper of these layers can reduce increase and electrical resistance together with the copper foil sheets 96 and 98.
[0078]Finally, the pattern of electric wiring is formed in the upper surface and the following table side of a layered product. In order to form the pattern of the electric wiring of the upper surface of a layered product, resist is applied on the metal skin 106 on the copper foil sheet 98 by the side of the upper surface, and it is made to dry first here. About the copper foil sheet 96 by the side of the following table side of the layered product which does not perform pattern formation of electric wiring yet at this time, and the metal skin 106 on it. In order to prevent being etched, the entire surface of the metal skin 106 on the copper foil sheet 96 by the side of the following table side of a layered product is applied and dried, and resist is covered to it. Then, after exposing and developing the resist on the metal skin 106 by the side of the upper surface of a layered product using an exposure mask with a desired electric wiring pattern, it is immersed in an etching reagent, and the unnecessary copper foil 98 and the metal skin 106 by the side of the upper surface are dissolved and removed. Next, by removing the resist which covers the resist [which remains in the upper surface side], and following table side side, the pattern of the electric wiring 108 which consists of the copper foil 98 and the metal skin 106 is formed in the upper surface of a layered product. Next, by patterning the copper foil sheet 96 by the side of the following table side of a layered product, and the metal skin 106 on it in the same procedure as the formation process of the electric wiring pattern by the side of the upper surface of an above-mentioned layered product, The pattern of the electric wiring 109 which consists of the copper foil 96 and the metal skin 106 is formed in the following table side of a layered product (drawing 9 (C)). When applying resist, resist enters in the through hole 104, and the resist in this through hole is also removable in the case of the above-mentioned resist removal. The method which it was not restricted to an above-mentioned method, for example, was explained by a 2nd above-mentioned embodiment can also be used for the formation method of the pattern of this electric wiring 108 and 109.
[0079]By the above process, the electric wiring and the optical wiring mixed-loading multilayer substrate which laminated one layer of optical wiring layers and five layers (however, layer with same one layer of optical wiring layers and electric wiring layer 1) of electric wiring are completed. According to this embodiment, the multilayer-structure board of the electric wiring and optical wiring mixed loading which laminated one layer of optical wiring layers and five

layers (however, layer with same one layer of optical wiring layers and electric wiring layer 1) of electric wiring is realizable, (1) the increase of the flexibility of electric wiring and optical wiring, and (2) -- since a wire length can be shortened, the strength reduction of an electrical signal and a lightwave signal and delay can be reduced again, or the influence of a noise can be reduced, and densification of the mounting of (3) electrical parts and an optical component can be carried out.

[0080]It also becomes possible to also take the electrical link of the electric wiring between layers by formation of a through hole and formation of a through hole plated section and to wire short by being possible or to make wiring into ground potential in common between layers, and they can also reduce electrical noise. Since the printed circuit board by which art is already established is used as electric wiring, the performance and reliability of an electric wiring part are securable.

[0081]In this embodiment, although the conductor seat (copper foil sheet) is pasted together via prepreg, it is possible to paste together to a flexible optical waveguide sheet directly by heating and sticking by pressure as well as the technique of a 1st embodiment and a 2nd embodiment.

[0082]Although this embodiment shows the example which has not provided electric wiring in the surface of the flexible optical waveguide sheet, The flexible optical waveguide sheet in which the pattern of electric wiring was formed on one side of a flexible optical waveguide sheet or both sides may be used like the technique of a 1st embodiment and a 2nd embodiment. By doing so, it can be considered as still higher-density wiring. **** to which form a beer hall in, perform plating treatment of the surface of a beer hall, etc. for the electric wiring connection between layers, and the electrical link between the arbitrary electric wiring between arbitrary layers is made to perform -- it can also be made like.

[0083][A 4th embodiment] A 4th embodiment of this invention is described below. In this 4th embodiment, the manufacturing method of the electric wiring and the optical wiring mixed-loading multilayer substrate considered as the composition which plans optical coupling with optical components mounted in the optical waveguide in the electric wiring and the optical wiring mixed-loading multilayer substrate produced by a 3rd embodiment and the surface of this multilayer substrate, such as a photo detector or a light emitting device, is explained. Hereafter, a 4th embodiment is described with reference to drawing 10.

[0084]First, the electric wiring and the optical wiring mixed-loading multilayer substrate produced according to the manufacturing process explained by a 3rd embodiment are produced. The structure of this multilayer substrate turns into structure shown in drawing 9 (C) explained by a 3rd above-mentioned embodiment. The section in the vertical direction of the space in alignment with cutout line X-X in this drawing 9 (C) is shown in drawing 10 (A). As shown in this drawing 10 (A), an optical waveguide part comprises the core 68a and the clad

70x (as 70x, this sectional view shows the upper clad 70 and the lower clad 72).

[0085]Subsequently, it is processed into the portion which takes out the light of this electric wiring and optical wiring mixed-loading multilayer substrate by laser beam exposure, and the cylindrical opening 110 with a diameter of 125 micrometers which penetrates a substrate is formed (drawing 10 (B)). On the other hand, a 90-degree deflection mirror is produced using the multimode optical fiber of a quartz system. The multimode optical fiber of this quartz system is outside 125micrometerphi, and the portion of central 50 micrometerphi uses what is a core. And the tip of this fiber is cut as the angle of that section will be 45 degrees, and optical polish of the cutting plane is carried out further. Then, aluminum (aluminum) is vapor-deposited in thickness of 0.1 micrometer with vacuum deposition in this cutting plane, the mirror part 114 is formed, and the 90-degree deflection mirror 112 which consists of a fiber part and a mirror part is completed.

[0086]Subsequently, after inserting in the opening 110 the above-mentioned 90-degree optical deflection mirror 112 (however, a mirror part 114) produced by the optical fiber and coinciding the height of the center of a mirror surface, and the center of the core 68a of an optical waveguide, the fiber part circumference of the 90-degree deflection mirror 112 is fixed with adhesives. Thereby, 90 degrees of lightwave signals L which have spread the core of the optical waveguide of electric wiring and an optical wiring mixed-loading multilayer substrate are deflected, and outgoing radiation of them is attained to above (namely, the direction of the surface of a multilayer substrate).

[0087]Subsequently, as the opening 110 is plugged up and it is located above the 90-degree deflection mirror 112, the photo detectors 120, such as a photo-diode and a photo-transistor, are mounted in the surface of electric wiring and an optical wiring mixed-loading multilayer substrate (drawing 10 (C)). This photo detector 120 is electrically connected to the electric wiring 108 on the surface of a multilayer substrate. Thus, the lightwave signal L which has spread the core 68a of an optical waveguide enters into the photo detector 120 via the 90-degree deflection mirror 112 (mirror part 114) by forming the opening 110 and mounting the 90-degree deflection mirror 112 and the photo detector 120.

[0088]According to this embodiment, the lightwave signal which has spread the core of the optical waveguide of electric wiring and an optical wiring mixed-loading multilayer substrate, 90 degrees can be deflected, it can be emitted upward and optical coupling can be carried out to the optical component mounted in the upper part, High-density electric wiring and optical wiring mixed-loading multilayer substrate which not only an electrical part but mounting of of optical components, such as a photo detector, was attained by this, and loaded together electric wiring and optical wiring, and loaded together the electrical part and the optical component are producible. Also in this embodiment, it has the same effect with a 3rd embodiment mentioned above having described.

[0089]Although this embodiment explained the example which used the photo detector as an optical component, it can replace with this and light emitting devices, such as a laser diode, can be used. In this case, 90 degrees of lightwave signals emitted from the light emitting device will be deflected by the 90-degree deflection mirror 112, will enter into the core 68a of an optical waveguide, and will spread the inside of the core 68a.
[0090]Although a 4th embodiment explained the example for performing optical coupling by mounting optical components, such as formation of an opening, mounting of a 90-degree deflection mirror, a photo detector, and a light emitting device, in the electric wiring and the optical wiring mixed-loading multilayer substrate produced by the method by a 3rd embodiment, The electric wiring and the optical wiring mixed-loading multilayered sheet created by the method by the electric wiring and the optical wiring mixed-loading multilayered sheet (flexible optical waveguide sheet of the multilayer structure which provided electric wiring on the upper clad layer), or a 2nd above-mentioned embodiment created by the method by a 1st above-mentioned embodiment. Also about (the flexible optical waveguide sheet of the multilayer structure which provided electric wiring on the upper clad layer and the lower clad layer), by the same technique as a 4th embodiment. The opening 110 can be formed, the 90-degree deflection mirror 112 can be mounted, optical components, such as a photo detector or a light emitting device, can be mounted further, and it can have an optical waveguide and composition which plans optical coupling of an optical component.
[0091]In a 3rd above-mentioned embodiment, one layer of optical wiring layers and five layers of electric wiring. Although the opening of the through hole was carried out to the electric wiring and the optical wiring mixed-loading multilayer substrate which laminated (however, the layer with same one layer of optical wiring layers and electric wiring layer 1) and the case where a through hole plated section was formed in the wall of this through hole and the substrate face of that neighborhood was explained, Also in the electric wiring and the optical wiring mixed-loading multilayered sheet concerning the 1st above-mentioned embodiment and 2nd embodiment, by the same technique as a 3rd embodiment, formation of a through hole and formation of a through hole plated section can be performed, and the electrical link of the electric wiring between layers can be made possible.
[0092]Although each above-mentioned embodiment explained the example which used the copper foil sheet as a conductor seat, it may replace with this and the sheet which comprises other conductive metals may be used.
[0093]
[Effect of the Invention]As mentioned above, as explained in detail, according to the manufacturing method of the electric wiring and the optical wiring mixed-loading multilayered sheet of this invention concerning the 1st embodiment and 2nd embodiment, vacuum devices are written by excluding a vacuum process as it is unnecessary, since it becomes producible

[the flexible optical waveguide sheet of a large area] and there is no vacuum process, productivity is markedly alike and improves, and in order not to use expensive vacuum devices simultaneously, it has the effect that low cost-ization is attained.

[0094]Since it is considered as the multilayer structure which provided the pattern of electric wiring in the surface of the flexible optical waveguide sheet in which electric wiring was made inherent, (1) the increase of the flexibility of electric wiring and optical wiring, and (2) -- since a wire length can be shortened, the strength reduction of an electrical signal and a lightwave signal and delay can be reduced again, or the influence of a noise can be reduced, and it has the effect that densification of the mounting of (3) electrical parts and an optical component can be carried out.

[0095]According to the manufacturing method of the electric wiring and the optical wiring mixed-loading multilayer substrate of this invention concerning the 3rd embodiment and 4th embodiment. The multilayer-structure board of the electric wiring and optical wiring mixed loading which laminated many optical wiring layers and electric wiring layers is realizable, (1) the increase of the flexibility of electric wiring and optical wiring, and (2) -- since a wire length can be shortened, the strength reduction of an electrical signal and a lightwave signal and delay can be reduced again, or the influence of a noise can be reduced, and it has the effect that densification of the mounting of (3) electrical parts and an optical component can be carried out further.

[0096]According to the manufacturing method of the electric wiring and the optical wiring mixed-loading multilayered sheet of this invention, and the manufacturing method of electric wiring and an optical wiring mixed-loading multilayer substrate. It is also possible to take the electrical link of the electric wiring between layers by plating a conductor to the wall of formation of a through hole or a beer hall, a through hole, or a beer hall, It also becomes possible to wire short or to make wiring into ground potential in common between layers, and has the effect that electrical noise is also mitigable.

[0097]According to the manufacturing method of the electric wiring and the optical wiring mixed-loading multilayer substrate of this invention, or electric wiring and an optical wiring mixed-loading multilayered sheet. By providing an opening and mounting optical components, such as a deflection mirror and a photo detector, or a light emitting device, The multilayer substrate or multilayered sheet of high-density electric wiring and optical wiring mixed loading which could plan optical coupling of an optical waveguide and an optical component, and loaded together electric wiring and optical wiring, and loaded together the electrical part and the optical component is producible.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1]A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet characterized by comprising the following.
A process of pasting a conductor seat together on the surface of a flexible optical waveguide sheet provided with an optical waveguide which consists of a core and a clad which were formed with a polymer material, and at least one field on the back.
A process of patterning said conductor seat after predetermined shape, and forming a pattern of electric wiring.

[Claim 2]A manufacturing method of electric wiring and the optical wiring mixed-loading multilayered sheet according to claim 1 currently making a pattern of electric wiring further inherent in said flexible optical waveguide sheet.
[Claim 3]In said process of pasting a conductor seat together to the surface of said flexible optical waveguide sheet, and both sides on the back, and forming a pattern of electric wiring in said process of pasting a conductor seat together, A manufacturing method of electric wiring and the optical wiring mixed-loading multilayered sheet according to claim 1 or 2 forming a pattern of electric wiring in both sides of said flexible optical waveguide sheet.
[Claim 4]Before said process of pasting a conductor seat together, A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet given in a claim of either claim 1 having further a process of carrying out roughening treatment of each field of said flexible optical waveguide sheet and said conductor seat to paste together beforehand thru/or claim 3.
[Claim 5]A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet given in a claim of either claim 1 having further a process of forming a through hole or a beer hall in said flexible optical waveguide sheet, and plating a conductor to

a wall of the through hole concerned or a beer hall thru/or claim 4.
[Claim 6]A process of providing an opening in said flexible optical waveguide sheet so that an opening may be carried out including a position in the core formation area, It is located in a process of mounting a deflection mirror in the opening concerned, and the upper part of said deflection mirror, A process of being mounted in the surface of said flexible optical waveguide sheet, or one field of on the back, and mounting an optical component in which a core and optical coupling of said optical waveguide are planned via said deflection mirror, A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet given in a claim of either claim 1 preparing for a pan thru/or claim 5.
[Claim 7]A manufacturing method of electric wiring and an optical wiring mixed-loading multilayer substrate characterized by comprising the following.
A flexible optical waveguide sheet provided with an optical waveguide which consists of a core and a clad which were formed with a polymer material.
Paste together and laminate a printed circuit board which has electric wiring via prepreg, and.
A process of pasting together and laminating a conductor seat to a field where an opposed face with another side in either [at least] said flexible optical waveguide sheet or said printed circuit boards is opposite, and a process of patterning said conductor seat after predetermined shape, and forming a pattern of electric wiring.

[Claim 8]A manufacturing method of electric wiring and the optical wiring mixed-loading multilayer substrate according to claim 7, wherein said conductor seat pastes together and is laminated via prepreg in said process of pasting together and laminating a conductor seat.
[Claim 9]A manufacturing method of electric wiring and the optical wiring mixed-loading multilayer substrate according to claim 7 or 8 currently making a pattern of electric wiring further inherent in said flexible optical waveguide sheet.
[Claim 10]In said process of pasting together and laminating a conductor seat, to a field opposite to a field where said flexible optical waveguide sheet and said printed circuit board counter mutually. In said process of pasting together and laminating a conductor seat via prepreg, respectively, and forming a pattern of electric wiring, A manufacturing method of electric wiring and an optical wiring mixed-loading multilayer substrate given in a claim of either claim 7 patterning a conductor seat laminated, respectively and forming electric wiring via said prepreg on said flexible optical waveguide sheet and said printed circuit board thru/or claim 9.
[Claim 11]Before said process of pasting together and laminating a flexible optical waveguide sheet and a printed circuit board via prepreg, and pasting together and laminating a conductor seat, A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet given in a claim of either claim 7 having further said flexible optical waveguide sheet, said printed circuit board, and a process of carrying out roughening

treatment of each field of said conductor seat to paste together beforehand thru/or claim 10.
[Claim 12]A through hole or a beer hall is formed in a layered product formed of said process of pasting together and laminating a flexible optical waveguide sheet and a printed circuit board via prepreg, and pasting together and laminating a conductor seat, A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet given in a claim of either claim 7 equipping further a wall of the through hole concerned or a beer hall with a process of plating a conductor thru/or claim 11.
[Claim 13]A process of providing an opening so that an opening may be carried out including a position in a core formation area of said flexible optical waveguide sheet in a layered product formed from performing each process according to claim 7, It is located in a process of mounting a deflection mirror in the opening concerned, and the upper part of said deflection mirror, A process of being mounted in the surface of said layered product, or one field of on the back, and mounting an optical component in which a core and optical coupling of said optical waveguide are planned via said deflection mirror, A manufacturing method of electric wiring and an optical wiring mixed-loading multilayered sheet given in a claim of either claim 7 preparing for a pan thru/or claim 12.

[Translation done.]